

Ofcom Spectrum Advisory
Board
Annual Report 2010 - 2011

Publication date: 14 July 2011

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Section 1

Message from Ofcom's Chairman

Since its inception in 2004 OSAB has always played a strategic advisory role. OSAB has raised issues that have helped to ensure that Ofcom remains well informed about key sectoral trends.

In this last year, under its new Chairman, David Meyer, OSAB has offered insight and advice on a number of issues, ranging from the domestic consideration of how Ofcom will fulfil its new duties under the Digital Economy Act to the management of spectrum at the European level. OSAB has also provided useful insights into the future of mobile communications and digital terrestrial television. During the course of the year OSAB members were delighted to welcome back former members – Martin Cave and Stephen Temple – at two of its meetings.

It is always difficult to capture the work of a body like OSAB in an Annual Report. Most of the value that it provides is in the discussion and dialogue. Whilst this Annual Report records the wide range of areas that OSAB has turned its attention to, it inevitably fails to do justice to the full extent and value of its advice.

The Ofcom Board is very grateful to OSAB for all that it has done over the past year and looks forward to continuing its engagement with OSAB.

Colette Bowe

Ofcom Chairman

Section 2

Foreword by OSAB's Chairman

I felt deeply honoured when I was asked if I would like to take over as Chairman of the Ofcom Spectrum Advisory Board (OSAB) when Sir David Brown stepped down from that role at the end of May 2010. Sir David's Chairmanship of OSAB will be a hard act to follow and I hope very much to live up to the standards he set during his term of office. It is therefore with great pleasure that I write this introduction to the seventh annual report of the Committee.

The topics which OSAB has considered over the past year have been as diverse as in any of its previous years and are covered in the body of this report. For instance, we have looked at how Ofcom could rise to meet the challenges of copyright infringement in the digital age and pondered the future of spectrum management at the European level. We also considered the position of the citizen consumer in the digital age, recognising the difficulties that would be encountered in getting equipment manufacturers to sign up to a publicly recognised standard and pondered how can buyers of equipment, in the absence of such a standard, make the right purchasing decisions.

OSAB meetings are always characterised by the high quality of the dialogue between Ofcom and the Committee. It is evident from Ofcom's responsiveness to OSAB that it weighs OSAB's advice carefully. The energy with which OSAB continues to pursue its remit owes much to the value which Ofcom places on its work.

OSAB is embarking on its eighth year with its customary enthusiasm, and I am confident that, in due course, we will be able to report on another productive year. In the meantime, the members of OSAB hope that you will enjoy reading about our work in 2010-11.

Chairman, Ofcom Spectrum Advisory Board

Section 3

Introduction

Background

- 6.1 The Ofcom Spectrum Advisory Board (OSAB) was established on 19 May 2004 to provide independent advice to Ofcom on strategic spectrum management issues. OSAB provides Ofcom with:
- A rapid way to test new ideas across a wide range of experts.
 - A means of identifying issues that are beyond Ofcom's regulatory "headlights".
 - A demonstration of Ofcom's commitment to consult in an open and collaborative manner.
 - A mechanism to help reach an agreed industry view of difficult and contentious issues through the hosting of open fora.
- 6.2 This document reports on its seventh year.

Terms of reference

- 6.3 In 2008 the terms of reference for OSAB were revisited. Ofcom and OSAB agreed that although OSAB's initial role had been to provide advice to Ofcom on spectrum-related matters; it was increasingly difficult to consider spectrum-related matters in isolation in a converging world.
- 6.4 Hence it was decided that OSAB's remit should be broadened to include all future communication architectures, access methods, physical layer technologies, spectrum issues, services and applications. OSAB would be responsible for high level and longer term vision and not for detailed assessment of different approaches, standard setting or consensus building amongst industry. However, it would not involve itself with content matters.
- 6.5 OSAB has steadily expanded its activities to reflect this broader remit over the year.

Membership

- 6.6 One third of OSAB retires each year. In May 2010 Sir David Brown, Barry Evans and Will Stewart stepped down. They were replaced by Robin Foster, Jean-Jacques Sahel and Mike Walker.
- 6.7 Details of OSAB membership including the length of tenure are at [Annex 2](#).

Work Programme

- 6.8 OSAB meets 5-6 times a year and holds an annual workshop where a whole day is devoted to a particular issue.
- 6.9 OSAB is responsible for agreeing its own work programme. During its seventh year a theme underlying much of OSAB's discussions was the changing nature of communications regulation. Key discussion items were:

- Whether radio receiver performance should be regulated.
- The Digital Economy Act 2010 and how Ofcom's duties should be changed as a result.
- The future of EU spectrum management and market regulation
- How Ofcom might re-establish the momentum of its early years
- Possible future mobile architectures and resulting regulatory implications
- The future of DTT

The Year Ahead

6.10 OSAB sets its agenda from meeting to meeting depending on progress made in particular areas, time available and topics arising. It deliberately does not plan a year ahead to allow for flexibility and responsiveness.

Further Information

6.11 For further information on the work of the Ofcom Spectrum Advisory Board, please contact the OSAB Secretary:

Mr Paul Rogers
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
Tel: 020 7783 4031
E-mail: paul.rogers@ofcom.org.uk

6.12 Or visit the OSAB website at www.osab.org.uk/ .

Section 4

Topics considered during the year

Receiver issues

- 7.1 OSAB received a briefing on the problems caused by poor receivers at 800MHz (television receivers) and 2.6GHz (radar receivers). The key points were:
- Ofcom generally did not set receiver standards, expecting that the market or standards bodies would set them appropriately.
 - However, there were important areas where receivers had not been specified appropriately (eg DTT receivers causing problems due to 800 MHz cellular deployment). These made spectrum release problematic and due to the need for interference avoidance reduced the economic value of the radio spectrum as a whole.
- 7.2 Ofcom had identified three possible solutions to receiver problems:
1. Let market forces solve the problem
 2. Regulatory involvement to influence standards bodies (eg such naming and shaming of poor quality receivers or the introduction of a “kitemark”)
 3. Direct regulatory involvement to set receiver standards
- 7.3 OSAB members thought that, along the lines of Ofcom’s second option, manufacturers should be encouraged to sign up to a publicly recognised standard and have their goods certified against that standard. This would prevent established manufacturers of good quality equipment being squeezed out of the market by manufacturers of cheap low quality goods. OSAB also thought that consumers who bought non-compliant equipment might be able to pursue a case under fair trading legislation. OSAB, however, noted that some information might be too technical for consumers to readily understand and that there might be little incentive for equipment manufacturers to adopt standards.

Digital Economy Act 2010 and Ofcom duties

- 7.4 OSAB members were briefed by Ofcom on Government proposals to give Ofcom the new duties introduced in the Digital Economy Act 2010 (DEA) aimed at reducing online copyright infringement. The DEA imposed new obligations on Internet Service Providers (ISPs) to send notifications to their subscribers upon being informed of a copyright infringement. Ofcom proposed that, initially, ISPs with more than 400,000 subscribers would be subject to the requirement so that 96% of the UK market would be covered. Mobile operators would be initially excluded but this exclusion would be periodically reviewed to take into account changes in technologies.
- 7.5 OSAB thought that the three-stage notification approach proposed by Ofcom effectively captured the intentions behind the DEA .. Ofcom would report on the effectiveness of measures to educate consumers and identify any problems hampering the switch to lawful services.

- 7.6 OSAB noted that online business models were still uncertain and that there had been no independent and robust assessment of the extent of online piracy. OSAB members thought that a legislative approach on its own was unlikely to be successful and that Ofcom should work with all parts of the industry to address the problem.

EU spectrum management and market regulation

- 7.7 OSAB members were provided with a briefing on EU spectrum management issues from Ruprecht Niepold, advisor on Radio Spectrum Policy for the European Commission.
- 7.8 OSAB noted that there were three trends shaping future spectrum policy:
- the increase in the usage of radio spectrum, particularly in personal communications, short range wireless and satellite communications
 - the increasing trend towards network convergence through the merger of mobile and fixed networks
 - the evolution of businesses and markets using radio spectrum through the increasing flexibility of network usage, competition between service and access providers and globalisation of networks
- 7.9 Four challenges for future spectrum policy were identified:
- responding to scarcity by the development of efficient radio technologies using less spectrum, promotion of shared use of spectrum and overcoming inefficiencies resulting from the fragmented use of spectrum
 - diversity of radio access methods, fostering the development of new radio access forms, facilitating economies of scale to support variety of access and increasing the flexibility of spectrum usage to allow deploying of different radio access forms
 - enabling new business models and players, allowing new entrants and integrating legacy spectrum rights holdings, adapting usage rights to new business demands and facilitating interoperability of radio access
 - developing an internal EU market to enable aggregation of spectrum and to put in place coherent spectrum access and usage regulation
- 7.10 OSAB considered that measures might be needed to attract genuine new entrants into the market. OSAB also thought that there needed to be scope to make spectrum available to facilitate innovation and the roll-out of new services.
- 7.11 OSAB wondered whether there might a role for the ITU to promote the development of standards world-wide. It was thought that the EU might be too small a market for consumers to benefit from the economies of scale in wireless. OSAB appreciated there might be a danger of regional polarisation on standardisation.
- 7.12 OSAB also thought that there might be a need for regulatory involvement to ensure that a sufficient pool of spectrum becomes available where standards can apply to foster development of new technologies. OSAB recognised that some Member States had strategies in place and advocated the adoption of a five to ten year EU level strategy ensure this occurred in all Member States. OSAB recognised that the EU could not always speak with one voice as that would damage the interests of

individual member states and that it would be necessary to determine whether or not a coherent EU approach would represent added value.

How Ofcom might re-establish the momentum of its early years

7.13 Ofcom had long been considered one of the leaders in spectrum regulation. To set the scene for its annual Workshop OSAB considered to what extent the UK could still be classed as a leader amongst its international peers. The discussion focussed around progress in public sector spectrum reform and in enabling smart radios.

7.14 **Public sector reform in Europe:** OSAB noted that 'public sector' allocations accounted for about 50% of all spectrum allocations but that administered incentive pricing (AIP) for the promotion of efficient use of spectrum only applied to some public sector uses. A study had taken place examining best practice in public sector spectrum management and the findings indicated:

- a patchy understanding or recording of current spectrum use and little planning for future requirements
- a potential to release or share spectrum
- a potential for incentives to promote more efficient public sector use of spectrum
- that spectrum access rights were often poorly defined and not time related

7.15 OSAB noted that an EC discussion paper, which included a section on the efficient use of spectrum for public use, was published in March 2010 and that the Radio Spectrum Policy Group had issued an opinion in June 2010 on the Radio Spectrum Policy Programme. This included a discussion of how EU governance could promote an internal market and how commercial and public sector use could align with EU objectives.

7.16 Some of the key issues that OSAB were asked to consider included:

- whether a lack of accurate information on public sector use was a major impediment to change?
- would changing the financial incentives facing public sector users be enough to result in spectrum release?
- were current 'licensing' arrangements/poor definitions of 'rights' a significant problem?
- did spectrum sharing or release in public sector bands needed to be harmonised across Europe?
- what institutional issues needed to be addressed, either in the UK or at a European level?

7.17 OSAB considered these questions and concluded that public sector allocations of spectrum should create opportunities for a more efficient management of spectrum but that there was a risk of inertia from public bodies. Consideration might be given to a defined end date for all spectrum licences issued to public sector bodies. In the current economic climate, there should be a financial incentive on the MOD to release spectrum.

- 7.18 **Smart Radios – new directions in spectrum policy:** OSAB were briefed on the development of Smart Radios in the US, including:
- Software Defined Radios which could be upgradable in the field, allowing radios to improve and innovate
 - Cognitive Radios which could operate in complex radio emission environments, using spectrum more efficiently
 - Dynamic Spectrum Access where devices would opportunistically seek out unused spectrum
- 7.19 OSAB thought that the capability of software defined radio would be limited by the processing capabilities of the chips –which would improve over time. Incentives might be needed to encourage software developers to enter the market and for manufacturers to design devices which would make efficient use of ‘white space’.
- 7.20 OSAB suggested that property rights should be better developed so that harmful interference to other users of spectrum could be avoided and an assessment made as to the current costs of spectrum interference. Regulators at the EU level or beyond needed to act in a converged manner and Ofcom, as a thought leader in spectrum, had a role to play in a global debate on defining harmful technologies.

Possible future mobile architectures and resulting regulatory implications.

- 7.21 In accordance with its remit to consider the future communications landscape from a range of perspectives, OSAB discussed the regulatory re-positioning that might be needed to best meet the new challenges of the coming mobile broadband network revolution. OSAB was delighted to welcome Stephen Temple, a former OSAB member, to the discussion.
- 7.22 By 2014 usage from mobile devices is predicted to have risen to 3.6 terabytes per month (with 66% of the demand estimated to be from video) and, by the same year, the number of mobile internet users would exceed the number of desktop internet users. OSAB were concerned about the prospects of a speed-related digital divide emerging when customers take up the new generation of technologies which, due to the nature of the network and radio wave propagation effects would mean that the best performance would only be available to customers who were in close proximity to transmitters. Whilst mobile operators could re-arrange network resources to give all users the same speed, that would result in none of the subscribers being able to receive multi-Mbit/s data rates. This was thought to be an unrealistic scenario.
- 7.23 It was also possible that mobile operators would arrange network resource to maximise headline speeds for the few in order to promote and sell the service. This would have the effect of exacerbating the speed-related digital divide as it was estimated that around 80% of consumers would not receive the expected standard of service. One solution would be for many more base stations to be placed where data speeds from existing base stations were low. This would give a huge gain in speeds but substantial investment would be required. Should no action be taken it appeared possible that, within five years, there would be a capacity crunch and the death of current mobile network competition.
- 7.24 OSAB considered that the following potential solutions were worth further consideration:

- Government could set the targets for a robust high performing UK broadband network
- a new regulatory framework which OSAB termed “High –speed Competitive Network Sharing” (HS-CNS) could allow national inter-system roaming across all mobile networks based upon an agreed universal minimum data speed. Network operators would be responsible for meeting roaming fees and would have a significant incentive to roll out new base stations in ‘low speed’ areas to reduce costs
- a spectrum auction facilitating a national 800MHz broadband mobile foundation layer at 100Mb/s to close the digital divide
- a scaling down of GSM to a single high integrity ‘thin layer’ for critical short messages
- one 20MHz paired channel at 2.6GHz liberalised for private Femto Cells
- a more holistic political and regulatory approach between fixed and mobile broadband network infrastructures to be adopted to address back-haul bottlenecks

7.25 Three major challenges were identified:

- a massive mobile network capacity shortfall was looming
- the UK had a comparatively poor capital climate for mobile network up-grading relative to all other large EU countries
- the 20th century mobile network competition model was on track to become dysfunctional over the next 3-4 years

7.26 However, it remained unclear to OSAB whether regulation was needed to deliver mechanisms such as the HS-CNS that might overcome these issues or whether the market incentives would be such that players taking advantage of the enhanced data rates and lower costs would naturally emerge.

The Future of DTT

7.27 OSAB considered the future of digital terrestrial television (DTT) from a range of perspectives:

- Mobile operators
- Characteristics of the DTT Platform in 2010
- Economic issues
- Lessons learned from the US Digital Television Transition
- Impact on Consumer Home Technology

7.28 **Mobile operators:** that it was inevitable that content viewing would change with everything being personalised and time-shifted. Whilst statistics still showed people sitting in family clusters and watching linear television, that was expected to change

- quite quickly. Operators thought that the internet would quite probably become a full substitute for provision of television services.
- 7.29 OSAB thought there was a tendency in the UK for service industries to hang onto spectrum and resist change as that would require capital investment and there was a risk that the UK would get out of alignment with the rest of Europe. A key message from all operators was that, whatever the future on spectrum, the UK must be fully aligned and harmonised with what was happening in Europe.
- 7.30 **Characteristics of the DTT Platform in 2010:** OSAB noted the current importance of the DTT platform, but acknowledged that DTT faces significant competitive and technology challenges – including a need for more spectrum if it is to match the HD and 3D capabilities of other platforms. OSAB also noted the drift away from communal watching to personal time-shifted watching. It was noted that some programmes had to be watched at the time of broadcast so that viewers could advantage of interactive elements such as viewer voting. The increasing trend to personalise viewing schedules raised a question on future relevance of linear broadcast services.
- 7.31 **Economic Issues:** OSAB considered that there were potential competing new uses for the spectrum currently used by DTT but reallocation to these uses would not readily occur through a market process and there was therefore a need for regulatory intervention. In order to determine the nature of that intervention OSAB thought that a cost benefit analysis would be needed at the European and, possibly, national level as well. Public as well as private costs and benefits would need to be taken into account.
- 7.32 A further issue to be addressed on the future of television that was identified by OSAB was that while some countries had quite a heavy dependence on DTT in other countries it had no role to play (ie transmission was by cable or satellite).
- 7.33 **Lessons learned from the US Digital Television Transition:** the use experience brought starkly illustrated the long time scales needed to achieve transition – the process had taken 22 years from initial consideration to final analogue switch off. It was thought that the Federal Communications Commission (FCC) had placed too much trust in broadcaster's estimates of spectrum requirements and that this had resulted in too much spectrum left in the hands of US TV broadcasters. Also that the spectrum footprints were too small – market transactions since the auction revealed a need to consolidate spectrum into bigger blocks.
- 7.34 OSAB also thought that the mix of large and small geographies had generated transaction costs. Smaller geographies would help provide expansion for larger networks and opportunities for smaller players. The FCC decision to go forward with allowing unlicensed use of TV white spaces prior to the next transition had created 'incumbency' on the part of white space proponents who might oppose a future repacking of the spectrum for other licensed users. It was also noted that the US free to air broadcasters had begun to roll out mobile TV but to date there was very little evidence of demand for it in the market. Instead there was much more use of video to mobile devices which was likely to be driven further by the increasing use of Tablet devices.
- 7.35 **Impact on Consumer Home Technology:** one of the clear messages was the complexity of the technology and the help that would be needed by consumers to manage it. There was a possibility that TV manufacturers would create 'walled

gardens' such as that of YouTV in order to control the user experience and also offer internet access.

- 7.36 OSAB recognised that there were some significant vested interests among the broadcast community in the UK and that no broadcaster would voluntarily give up spectrum. Whilst there had been very good public policy reasons for establishing DTT in the first place (ie to protect public service broadcasting, ensure universal coverage of TV and platform choice, etc) a question going forward was whether these reasons were still as relevant in a changed world. On the one hand, a successful DTT platform would need to keep pace with improvements offered by satellite and cable. On the other hand, over time free to air linear broadcasting might become less critical as content was increasingly sourced from the internet which would be the most efficient means of allowing people to watch TV when they want to. Given this, OSAB noted the importance of planning for the future of DTT, including setting a timescale for DTT switch-off alongside other options.

Section 5

Annual Workshop

Theme

- 5.1 Each year, OSAB dedicates a whole day to a more detailed consideration of a particular issue. This year, OSAB chose 'UK initiatives in spectrum management: how they have fared over the past five years and whether changes in course were needed'. The event started with a briefing from Professor Martin Cave, a former OSAB member, on the two reviews of spectrum he had carried out in 2002 and 2005 and on the progress towards implementation.
- 5.2 **Spectrum trading:** OSAB noted that, with the exception of the US and the special cases of Guatemala and San Salvador, limited progress had been made around the world in relation to spectrum trading. In the US trading had been driven by the need to consolidate to regional and national levels. The low volume of trading in the UK was thought to be due to the structure of the communications industry and the way in which the operators interacted.
- 5.3 **Spectrum pricing:** OSAB agreed that the use of market-like instruments to nudge resource allocation to become more efficient had been a good idea. There was, however, no strong evidence in the private sector that spectrum pricing encouraged more efficient use of resources. The risk in the public sector was that it could easily turn into a "money go-round". As part of the 2010 Comprehensive Spending Review the Treasury looked ahead for the next four years at the allocation of funding to departments to pay for spectrum on its assessment of needs and the prices it would charge. An interesting development was the scope for cross border transactions between the public and private sector spectrum markets. The Ministry of Defence had taken the lead in identifying spectrum for sale or release – but there were possible problems as the spectrum was unlikely to be matched by spectrum available in other countries. This would imply limited availability of equipment which might lead to a lower value being placed on the spectrum than would otherwise be the case. A further concern was that the Treasury might not allow departments to retain sufficient income generated in order to provide an incentive for them to trade.
- 5.4 **Challenges:** According to the Cisco Virtual Network Index, mobile traffic in the UK would increase by 31 times between 2009 and 2014. Little reference had been made to re-farming in the two Cave reports and it was suggested that, in the absence of trading and with limited effective pricing, re-farming would acquire a much greater importance.
- 5.5 **Awards and re-farming:** it was suggested that if awards were likely to be subject to litigation the sooner they were progressed and litigation dealt with the better. If there were some impediments to trading, some periodic auctions could help replace that trading. There was a risk that spectrum might be purchased and warehoused as a means of preventing new entrants into the market. If that was a risk, a possible way forward might be to hold very large ("big bang") auctions and include some form of caps in it – which would create a set-aside for new entrants. A further consideration was that, if there was a less stable structure in the mobile sector there might be a higher level of trading and reconfiguration of services.
- 5.6 OSAB thoughts on the issues presented to it by Professor Cave included:

- One interpretation was that despite best efforts, little real progress had been made on the implementation of the recommendations from the two Cave reports. OSAB suggested that thought should be given to what the role of the regulator needed to be to drive change, including consideration of the role for a more proactive spectrum regulator/planner/manager. What would that mean for spectrum planning and for the strategic approach to spectrum awards? Should the regulator have a spectrum broker role to try to make the market work better than it might otherwise do left to its own devices? Perhaps there might be a role for a single body to interface between the private and public sector.
- Unlike the US, licences in the UK were awarded on a nationwide basis. The original fragmentation of licensing in the US based on political rather than economic decisions had driven the need for trading in order to build regional/national licences.
- At what point would new technologies change the assumption of exclusive spectrum? Could there be dynamic sharing? OSAB suggested that alongside the “big bang” auction idea consideration should be given to how to change the use of bands, with reference made to the idea of voluntary reallocation.
- To what extent was regulatory intervention necessary to achieve spectrum trading? OSAB suggested the adoption of a set of protocols for sharing property rights which could become the focal point for communication between the parties.
- Whilst OSAB thought that Ofcom was right to be focussing currently on release of the 800MHz and 2.6GHz bands that would be a drop in the ocean in terms of meeting the requirements for a 31-fold increase in traffic. Spectrum policy needed to be considered in the context of other levers, eg, what happens with small sites, femtocells etc. New entrants might be able to cherry pick the traffic they carry with small cells and some access to the wider network to join up the dots without needing extra spectrum. OSAB suggested that there was some over emphasis on spectrum being the answer to all capacity challenges.
- For trades to happen there needed to be a lot of value on the table. Also spectrum had to be tradable and most spectrum in Europe still was not. The arrival of piecemeal offerings into the market helped to freeze trade.
- It was suggested that Administrative Incentive Pricing (AIP) should be corralled primarily into areas where there could be no trading.
- Incentives were needed so that public spectrum was released in a way that maximises use and value, rather than the incentive just being to stop paying AIP. OSAB wondered whether an option might be for a leasehold approach

where the buyer would take over responsibility for making AIP payments to the Treasury.

- Consolidation in the UK mobile sector might be being driven by the need for more capacity to deliver enhanced services.
- Reference was made to the possibility of harmonised pan-European services which would eliminate roaming issues. This was the sort of area where high level regulatory reform might open up possibilities.
- Whether there was a role for Ofcom in relation to MVNOs and building a ladder of investment. Whilst allocation to the buyer with the greatest ability to pay might maximise revenue generated there might also be scope for considering allocation to achieve the best welfare for society as a whole. OSAB noted the constraints of the EU regulatory regime in that dominance would have to be proven before access could be mandated to the mobile sector.
- OSAB felt that developing new areas was not just a question of ensuring more efficient use of spectrum but also addressing issues such as focussing on backhaul and femtocells, fixed to mobile infrastructure, getting more efficient roll out of fibre and increasingly technologies that enable smooth transition.
- What was the role for satellite in developing mobile broadband capability?
- What would be the best instrument to achieve “Cave 2” in a reasonable time so as to avoid a potentially unwelcome amount of consolidation in the market?
- The Commission’s Radio Spectrum Programme which included some good ideas, for example, an inventory of spectrum including the degree to which it was used and needed for its current use.
- Spectrum may not be used for the best purpose because of the need for protection clauses to allow mobile operators to sit next to broadcasters, eg, 600MHz. A big bang approach to auctions might allow for defragmentation and the creation of significant additional value.
- It was suggested that the aim should not necessarily be to find the most efficient ways to make use of spectrum and profit from it but to deploy services.
- High spectrum prices reflected a failure to get spectrum into the market and artificial scarcity. Low prices could lead to increased welfare gains. It was

suggested that through trading the aim was to migrate spectrum to the uses and people who value it most including those who will innovate and provide services that consumers will value. It was imperfect but better than a command and control administrative process.

- OSAB thought that it could be of huge benefit to Europe to have four pan-European providers but not in equilibrium so that they would need to innovate.
- When considering the demands on spectrum there was a need to look at all uses of spectrum including Wi-Fi and other unlicensed uses, particularly as these may be key in supporting broadband services from handheld and untethered devices. Estimates varied that between 75 per cent and 95 per cent of mobile telephone use was indoors by people sitting down.
- A clear vision was needed of “why we care” which was not just about achieving better spectrum management but about encouraging and supporting new services.

Annex 1

Ofcom Spectrum Advisory Board – Terms of Reference

- A1.1 The Ofcom Spectrum Advisory Board is to provide independent, strategic advice to Ofcom, and where appropriate to Ministers, on matters that directly or indirectly have a bearing on policy issues to do with future communications architectures, access methods, physical layer technologies, spectrum, services and applications.
- A1.2 In formulating its advice, OSAB is to consider the future communications landscape from technological, economic and societal perspectives, consonant with Ofcom's statutory duty to further the interests of citizens in relation to communications matters.
- A1.3 In particular, OSAB is to advise on:
- Ofcom's spectrum strategy, major UK national allocation decisions, spectrum management, and the application of spectrum pricing/trading.
 - Issues that are currently "beyond Ofcom's headlights" to which Ofcom should start to give attention.
 - New communication technologies.
 - New means of managing the radio spectrum and their implications for Ofcom.
 - Whether Ofcom's current and developing policy stance is appropriate and where new policy might be needed.
- A1.4 For example, topics that might be considered by the OSAB include:
- The extent to which future wireless and fixed communications infrastructure and services may be complementary or compete with one another.
 - Novel technologies such as cognitive radio
 - Ongoing initiatives such as digital TV switchover.
 - Emerging uses of spectrum in areas such as transport and healthcare.
 - Ways to measure and assess the effectiveness of spectrum management policies.
 - The development of market-led initiatives such as SURs.
 - The balance between licensed and licence-exempt spectrum.
 - The stimulation of innovation through spectrum policy.
 - Trends in international relations.

- Ways that spectrum policy could be used to further the interests of the citizen and consumer.
- A1.5 To avoid any conflict of interest, members of OSAB will not have access to confidential information pertaining to Ofcom decisions affecting specific companies. This does not however preclude the discussion of potential Ofcom policies.
- A1.6 With the support of Ofcom staff, reporting shall include an Annual Report, publication of key findings on the Ofcom or OSAB website and hosting occasional Open Forums.
- A1.7 Members of OSAB should be drawn from a mix of commercial, academic and consulting backgrounds, in order to assess topics in a multidisciplinary manner, and to advise Ofcom on matters of strategic significance. Membership will include ex-officio representation by the Department of Business, Enterprise and Regulatory Reform (BERR) who will participate fully in discussions but reserve the right to abstain from agreement on substantive matters. Members will not receive remuneration other than reimbursement of expenses.

Annex 2

Membership of OSAB¹

David Meyer (Chairman) [May 2012]

David Meyer has been an officer within the British Army's Royal Corps of Signals since 1979. He has held posts including command of military units delivering operational information systems and services and a variety of office-based staff posts responsible for policy, procurement, operations, signals intelligence and computer network defence. His service has included work in Croatia, Bosnia, Kosovo and the Democratic Republic of Congo, as well as contributing to more recent operations in Iraq and Afghanistan. He is currently the Chief Information Officer for the Foreign and Commonwealth Office

Professor Linda Doyle [May 2012]

Linda Doyle is an Associate Professor in Trinity College, University of Dublin in the Department of Electronic & Electrical Engineering. Prof. Doyle received her Ph.D. in radio wave propagation in 1996 and has been a faculty member since then. She plays an active role in undergraduate and postgraduate teaching and in research. Prof. Doyle's leads a large research team working on wireless networking, software radio, cognitive radio, reconfigurable networks, dynamic spectrum access, spectrum trading and spectrum regulation. Professor Doyle and her team have built a strong reputation in the field of cognitive radio and dynamic spectrum access. They have published over 140 papers in the last few years. Professor Doyle has just recently published a book on cognitive radio, *The Essentials of Cognitive Radio* (Cambridge University Press). Linda is currently is vice-chair of the IEEE Technical Committee on Cognitive Networks.

Robin Foster [May 2013]

Robin Foster has occupied several board-level strategy and policy positions in the UK media and telecommunications sectors and is currently an independent adviser on regulatory, policy and strategic issues. He is a founding member of Communications Chambers, a media and communications consultancy.

Robin was part of the first senior team at the then newly-established regulator, Ofcom, as Partner, Strategy and Market Developments, where he led the first Ofcom review of public service broadcasting. His previous senior positions include director of strategy and regulation at the Independent Television Commission, director of strategy at the BBC, and director of economic consultants NERA, where he was responsible for a range of projects on privatisation, regulation and spectrum management.

Since leaving Ofcom, Robin has advised government in two roles: as a member of the UK Digital Britain Steering Board, which developed proposals for UK broadband communications sector policy and regulation and as one of the independent advisers to the UK Convergence Think Tank. He also ran the Global Communications Consortium research programme at London Business School until March 2008, and was Research Fellow at Bournemouth Media School from 2000 to 2002 where he led a programme of research into the future of media regulation in the UK ("Future Reflections").

¹ After each member is given the date that their appointments to OSAB expire.

Phillipa Marks [May 2013]

Phillipa Marks is a Director of Plum Consulting. She specialises in the analysis of economic, public policy and regulatory issues in the media and telecommunications industries. She is an expert in the application of market mechanisms to spectrum management. She was educated in New Zealand and at Oxford University. After a period as a research officer with the New Zealand Institute of Economic Research, she moved to the UK working for the Institute of Transport Studies. She then joined the National Economic Research Associates (NERA) where she became a director, leading assignments in media, telecommunications and utility sectors. In 2000, she was appointed by the Home Office as a member of the Gambling Review Body.

Philip Marnick [May 2012]

Philip is currently CTO of UK Broadband. Philip has spent over twenty years at the forefront of the wireless communications industry. Prior to joining UK Broadband, he held senior operational and strategic executive positions at O2, BT, Orange, J-Phone, Japan (now Softbank mobile), Extreme Mobile and SpinVox.

He has been involved with mobile networks from analogue through to the launch of the world's first GSM 1800 and 900 networks and on to Europe's first 3G network and the development of international roaming. Philip was instrumental in driving the development of mobile data services including the launch of the world's first camera phone and has been actively involved in the development of the mobile regulatory regime both in the UK and Europe. He was previously vice-chairman of the NICC and chairman of the PNO-IG.

Robert Pepper [May 2011]

Robert Pepper leads Cisco's Global Technology Policy team in areas such as broadband, IP enabled services, wireless, security, privacy and ICT development. He joined Cisco in 2005 from the FCC where he served as Chief of the Office of Plans and Policy and Chief of Policy Development beginning in 1989 where he focused on telecommunications regulation, spectrum policy, and policies promoting the development of the Internet. Before joining government, he held faculty appointments at the Universities of Pennsylvania, Iowa and Indiana, and was a research affiliate at Harvard University. He serves on the board of directors of the U.S. Telecommunications Training Institute (USTTI), advisory boards for Columbia University and Michigan State University, and is a Communications Program Fellow at the Aspen Institute. He is a member of the U.S. Department of Commerce's Spectrum Management Advisory Committee and the U.S. Department of State's Advisory Committee on International Communications and Information Policy. Pepper received his BA. and Ph.D. from the University of Wisconsin-Madison.

Jean-Jacques Sahel [May 2013]

Jean-Jacques is currently Director, Government and Regulatory Affairs, Europe, Middle-East and Africa, Skype. Jean-Jacques joined Skype from the British Government where he served UK interests in many telecoms and IT negotiations and forums. He was a Vice Chair of the OECD anti-spam task force and Chairman of the OECD working party on the information economy. Jean-Jacques was the UK signatory of the UN ITU Convention and Constitution and has Chaired the UK Chapter of the International Institute of Communications since 2009.

Professor Simon Saunders [May 2011]

Professor Simon Saunders is an independent specialist in wireless communications, with a technical and commercial background in both industry and academia. He is founder of the Real Wireless consultancy and founding chairman of the Femto Forum. He has more than 25 years' experience to CTO and CEO level in industry and as an academic for seven years. Simon has invented several novel wireless technologies and is the author of over 150 articles and books, including authoritative books on antennas, propagation and on femtocells, and is a regular speaker at industry conferences. He is a Visiting Professor to the University of Surrey.

Sam Sharps [ex officio]

Sam Sharps joined the Department of Trade & Industry in 1999, and following a secondment to Cable & Wireless rejoined the Department for Business in the summer of 2007. He has specialised in communications policy, having worked on the government strategy for ADSL rollout and led government relations with the UK's mobile network operators.

In 2008 he led the team supporting Francesco Caio in his review of next generation broadband, published in September that year. He became Project Director on the Digital Britain Report, working with Lord Carter to develop the first converged strategy for the communications sector.

Professor Tommaso Valletti [May 2011]

Tommaso Valletti is Professor of Economics at Imperial College London and Professor of Economics at the University of Rome. Tommaso is a member of the panel of academic advisors to Ofcom. He is also a member of the panel of academic advisors of the UK Competition Commission. He was a board director of Consip, the Italian Public Procurement Agency, in 2002-2005. He is Editor of *Information Economics & Policy* and Associate Editor of *Economica* and of the *Journal of Industrial Economics*. He has published widely in the academic literature on industrial economics, regulation, and telecommunications economics. He is a fellow of CEPR. He has advised numerous bodies, including the European Commission, OECD, and the World Bank on topics such as network interconnection, mobile telephony markets, and spectrum auctions.

Mike Walker [May 2013]

Mike was the Group Research and Development Director for the Vodafone Group of companies, with responsibility for the Group's research activities, intellectual property and technology standards worldwide. He is currently Executive Technical Advisor to Vodafone and Chairman of the Board of the European Telecommunications Standards Institute. He

holds the Vodafone Chairman in Telecommunications at Royal Holloway, University of London and is a visiting professor at the University of Surrey. Mike is Vice Chairman of the mobile VCE – a group of universities and industries researching mobile communications. He is a Fellow of the Royal Academy of Engineering and a member of the Council of the Academy. He is the current President of the Institute of Mathematics and its Applications. He was appointed an OBE in June 2009 for his services to the telecommunications industry.

Professor William Webb [May 2014]

William is one of the founding directors of Neul, a company developing machine-to-machine technologies and networks, which was formed at the start of 2011.

Prior to this William was a Director at Ofcom where he managed a team providing technical advice and performing research across all areas of Ofcom's regulatory remit. He also led some of the major reviews conducted by Ofcom including the Spectrum Framework Review, the development of Spectrum Usage Rights and most recently cognitive or white space policy. Previously, William worked for a range of communications consultancies in the UK in the fields of hardware design, computer simulation, propagation modelling, spectrum management and strategy development. William also spent three years providing strategic management across Motorola's entire communications portfolio, based in Chicago,

William has published eleven books, eighty papers, and four patents. He is a Visiting Professor at Surrey University and DeMontfort University, a member of Ofcom's Spectrum Advisory Board (OSAB) and a Fellow of the Royal Academy of Engineering, the IEEE and the IET where he is as a Vice President. His biography is included in multiple "Who's Who" publications around the world. William has a first class honours degree in electronics, a PhD and an MBA. He can be contacted at william.webb@neul.com.

Gavin Young [May 2012]

Gavin's current role is as Head of Strategy & Planning within Cable & Wireless Worldwide. He leads a team of architects responsible for the architecture and strategy for C&W Worldwide's technology platforms (Data, Internet, Voice, Mobile, Cloud/Hosting, Optical Transport, Access, Call Centre Solutions etc.).

Following a range of Access technology leadership roles within BT, Gavin joined AdEvia in 2000 where as CTO he led the design of pan-European broadband networks. He then moved to Bulldog Communications (later acquired by C&W Worldwide) where he held a variety of responsibilities from product development through to network operations and CTO. As C&W's Chief Architect for Access, Gavin was focused on the design and architecture of the national broadband network and the associated network products. He has also been heavily involved in regulatory aspects of broadband access and spectrum.

Gavin was a founding director of the Broadband Forum (formerly DSL Forum) was overall Technical Chairman for twelve years. In addition he has been co-chair of the UK21CN consultation's Broadband Group, chair of the UK NICC's DSL Task Group and also vice-chair of the NICC Ethernet Access Task Group. Gavin also serves on the Ofcom Spectrum Advisory Board (OSAB) which provides strategic advice to Ofcom and ministers.

